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National Aeronautics and
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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

DESIGN CRITERIA FOR CONTROLLING STRESS CORROSION CRACKING

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Prepared by
Materials & Processes Laboratory
George C. Marshall Space Flight Center

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Approved by	Organization	Date

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RELEASE

STRESS		MATERIALS	
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STRESS

Carmelo Bianca 8-11-87

MATERIALS

C F. Ky 8-5-87

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CHANGE 1			
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	15	15	
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3/15/88 EH RELEASE

MSFC - Form 3948 (March 1983) NOTE: After revising the document, file this sheet in document preceding table of contents.

properties, but comparative stress corrosion thresholds can be determined for materials for certain controlled conditions of test. Estimates of the stress corrosion threshold for a specific service application must be determined for each alloy and heat treatment using a test piece, stressing procedure, and corrosive environment that are appropriate for the intended service.

3.2 Limitations

The stress corrosion susceptibility of alloys included in this document was determined at ambient temperature by laboratory tests in which specimens were either sprayed with salt water or periodically immersed and withdrawn, by exposure of specimens in seacoast or mild industrial environments, and by service experience with fabricated hardware. Use of the criteria established herein should, therefore, be limited to designs for service involving similar exposure conditions. Behavior of the listed materials at elevated temperature, and in specific chemical environments other than those mentioned above, must be ascertained by additional testing.

Weldments present a special problem in designing for resistance to stress corrosion cracking. In addition to the susceptibility of the parent metals, it is also necessary to consider the filler metal and the microstructural effects of heat introduced by the welding operations and subsequent heat treatments. Because of the additional variables which must be considered, susceptibility data are not as extensive for weldments as for alloys in mill form. Design criteria for weldments in this document are limited to aluminum alloys, selected stainless steels in the 300 series, and other specific alloys listed in Table I.

This document is intended to provide general criteria to be used in designing for resistance to stress corrosion cracking. Specific test data and other detailed information are not included. However, a list of references is attached as Appendix A from which additional information can be obtained.

3.3 Grain Orientation

Rolling, extruding, and forging are the most common processing operations employed in the production of standard wrought forms of metal. All produce a flow of metal in a predominant direction so that, microscopically, the metal is neither isotropic nor homogeneous. As a result, the properties of the metal vary according to the direction in which they are measured. The extent of directional variation depends on the property of interest. For susceptibility to stress corrosion cracking, the directional variation can be appreciable and must be considered in the design of fabricated hardware.

The anistropy of grain orientation produced by rolling and extruding is illustrated schematically in Figure 1. Taking the rolled plate as an example, it is conventional to describe the direction of rolling as the longitudinal direction, the direction perpendicular to the longitudinal and in the plane of the plate as the long transverse direction, and the direction through the thickness of the plate as the short transverse direction. For certain shapes, it is not possible to distinguish both a long and short transverse direction based on the simple rules used to identify those directions for plate. As an example, consider the thick tee illustrated in Figure 2 where a region with both long and short transverse orientations has been identified based on experience with that particular shape and a knowledge of the forming method.

Forgings also require special consideration in identifying the short transverse direction. In a forging operation, the flow of metal is influenced and constrained by the shape of the die cavity. For complex shapes, there may be several regions where a short transverse direction exists. The direction perpendicular to the parting plane of the dies is always short transverse as illustrated in Figure 3.

The resistance of metals, particularly alloys of aluminum, to stress corrosion cracking is always less when tension is applied in a transverse direction. It is least for the short transverse direction. Figures 2 and 3 were drawn to illustrate undesirable situations in which tensile stresses due to assembly have been applied in the short transverse direction. For optimum resistance to stress corrosion cracking, similar situations must be avoided in structural design.

3.4 Stress Considerations

In designing for stress corrosion resistance it is important to realize that stresses are additive and threshold stresses for susceptibility are often low. There have been a number of stress corrosion failures for which design stresses were intermittent and of short duration, and only of minor significance in contributing to failure. Stress corrosion cracking in those cases occurred because of a combination of residual and assembly stresses not even anticipated in design. All possible sources of stress must be considered to ensure that threshold stresses are not exceeded. In addition to stresses resulting from operational, transportation, and storage loads which are anticipated during design; assembly and residual stresses also contribute to stress corrosion, and in many cases are the major contributors to stress corrosion failure. Assembly stresses result from improper tolerances during fit-up (Figures 2 and 3), overtorquing, press fits, high interference fasteners, and welding.

Residual stresses are present in components of fabricated structure as a result of machining, forming, and heat treating operations. Some typical residual stress distributions through plate and rod are illustrated in Figure 4 to provide an indication of the magnitudes of stress which can be developed as the result of conventional heat treating and forming operations.

3.5 Susceptibility of Engineering Alloys

a. Aluminum - Many aluminum alloys exhibit excellent resistance to stress corrosion cracking in all standard tempers. However, the high strength alloys, which are of primary interest in aerospace applications, must be approached cautiously. Some are resistant only in the longitudinal grain direction, and the resistance of others varies with the specific temper. Because metallurgical processing of aluminum alloys usually results in a pronounced elongation of grains, the variation of susceptibility with grain orientation is more extensive than for other metals. Also, because of conventional processing methods designed to optimize strength, residual stresses, especially in thick sections, are usually greater in aluminum products than in wrought forms of other metals. It is for this reason that wrought, heat treatable aluminum products specified for use in the fabrication of hardware should be mechanically stress relieved (the TX5X or TX5XX temper designations) whenever possible.

Both the residual stress distribution and the grain orientation must be carefully considered in designing a part to be machined from wrought aluminum. Machining will not only alter the stress distribution, but as indicated in Figure 2a, it may also result in the exposure of a short transverse region on the surface of the finished part which will see tension in service.

b. Steel - Carbon and low alloy steels with ultimate tensile strengths below 180 ksi are generally resistant to stress corrosion cracking. Austenitic stainless steels of the 300 series are generally resistant. Martensitic stainless steels of the 400 series are more or less susceptible depending on composition and heat treatment. Precipitation hardening stainless steels vary in susceptibility from extremely high to extremely low depending on composition and heat treatment. The susceptibility of these steels is particularly sensitive to heat treatment, and special vigilance is required to avoid stress corrosion cracking problems.

c. Nickel - As a class, alloys with high nickel content are resistant to stress corrosion cracking.

d. Copper - Natural atmospheres containing pollutants of sulfur dioxide, oxides of nitrogen, and ammonia are reported to cause stress corrosion cracking of some copper alloys. Chlorides present in marine atmospheres may cause stress corrosion problems but to a lesser extent than the previously listed pollutants, which indicates that industrial areas are probably more aggressive than marine sites to copper base alloys. Many copper alloys containing over 20 percent zinc are susceptible to stress corrosion cracking even in the presence of alloying additions which normally impart resistance to stress corrosion.

4. MATERIALS USAGE AGREEMENTS:

This document does not purport to be all inclusive of factors and criteria necessary for the total control of stress corrosion cracking in all alloys. It is recognized that for many applications involving unfamiliar materials, or unusual combinations of materials and environments, existing data on stress corrosion susceptibility will be insufficient. To ensure adequate stress corrosion resistance in these situations, it will be necessary to conduct a detailed evaluation of susceptibility. The results must be submitted to MSFC for review, and MSFC approval will be required before the material can be used or incorporated in a design under the circumstances in question. The medium for submittal will be the Materials Usage Agreement (MUA), a copy of which is attached as Appendix B. In addition, all materials applications other than those explicitly approved according to the criteria set forth in this document will be predicated on MSFC approval of an MUA submitted either by a prime contractor or by a subcontractor through the prime. The MUA will contain the information specified on the Stress Corrosion Evaluation Form, attached as Appendix C, along with any other information deemed necessary for the accurate assessment of the potential for stress corrosion failure. Where possible, similar usages of the same or similar alloys should be submitted on a single MUA.

5. MATERIALS SELECTION CRITERIA:

Alloys and tempers which by testing and experience have been shown to possess high resistance to stress corrosion cracking are listed in Table I. These should be used preferentially, and MSFC approval is not required prior to their use. All other alloys and weldments except those in Table I require that an MUA be submitted for approval.

Sheet material (less than 0.250 inch thick) of the aluminum alloys listed in Table II is considered resistant to stress corrosion and does not require

MSFC approval. In addition, alloys used for electrical wiring, thermocouple wires, magnet wires and similar non-structural electrical applications do not require MSFC approval relative to stress corrosion resistance.

All electroplated, anodized, and chemical conversion coatings on otherwise acceptable materials are excluded from the requirements of this specification. Similarly coated or plated parts made from susceptible materials are not excluded. For example, even though 2024-T3 aluminum is anodized and 440C stainless steel is chrome plated, these materials are considered to have low resistance to stress corrosion, and their use requires MUA's and Stress Corrosion Evaluation Forms.

Surface treatments such as nitriding and carburizing are also not excluded. In fact, these treatments may make a stress corrosion evaluation necessary for a material not normally considered susceptible. An example of this would be a low strength plain carbon steel carburized on the surface to a hardness corresponding to a tensile strength above 200 ksi. This steel would be considered to have low resistance to stress corrosion, regardless of the strength of the core material.

Alloys and tempers listed in Table II are moderately resistant to stress corrosion cracking. They should be considered for use only for cases where a suitable alloy cannot be found in Table I. An MUA must be submitted and MSFC approval must be given before any alloy or weldment in Table II can be used. Proposed utilization of materials from Table II in applications involving high installation stress, such as springs or fasteners, will not be approved.

Materials listed in Table III have been found to be highly susceptible to stress corrosion cracking. They should be considered for use only in applications where it can be demonstrated conclusively that the probability of stress corrosion is remote because of low sustained tensile stress (whatever its origin) in critical grain directions, suitable protective measures, or an innocuous environment. The use of materials in Table III must be substantiated by an MUA approved by MSFC.

The stress corrosion resistance of alloys and weldments not listed in this document must be ascertained either by tests conducted in an environment representative of the proposed application or by a direct comparison with similar alloys and weldments for which susceptibility is known to be low. An MUA must be submitted and approval obtained for each proposed application of an alloy or weldment not listed in this document. In special cases where specific data are already available on a material under environmental conditions representative of anticipated exposure conditions, an MUA for usage of this material within prescribed limits may be submitted for approval.

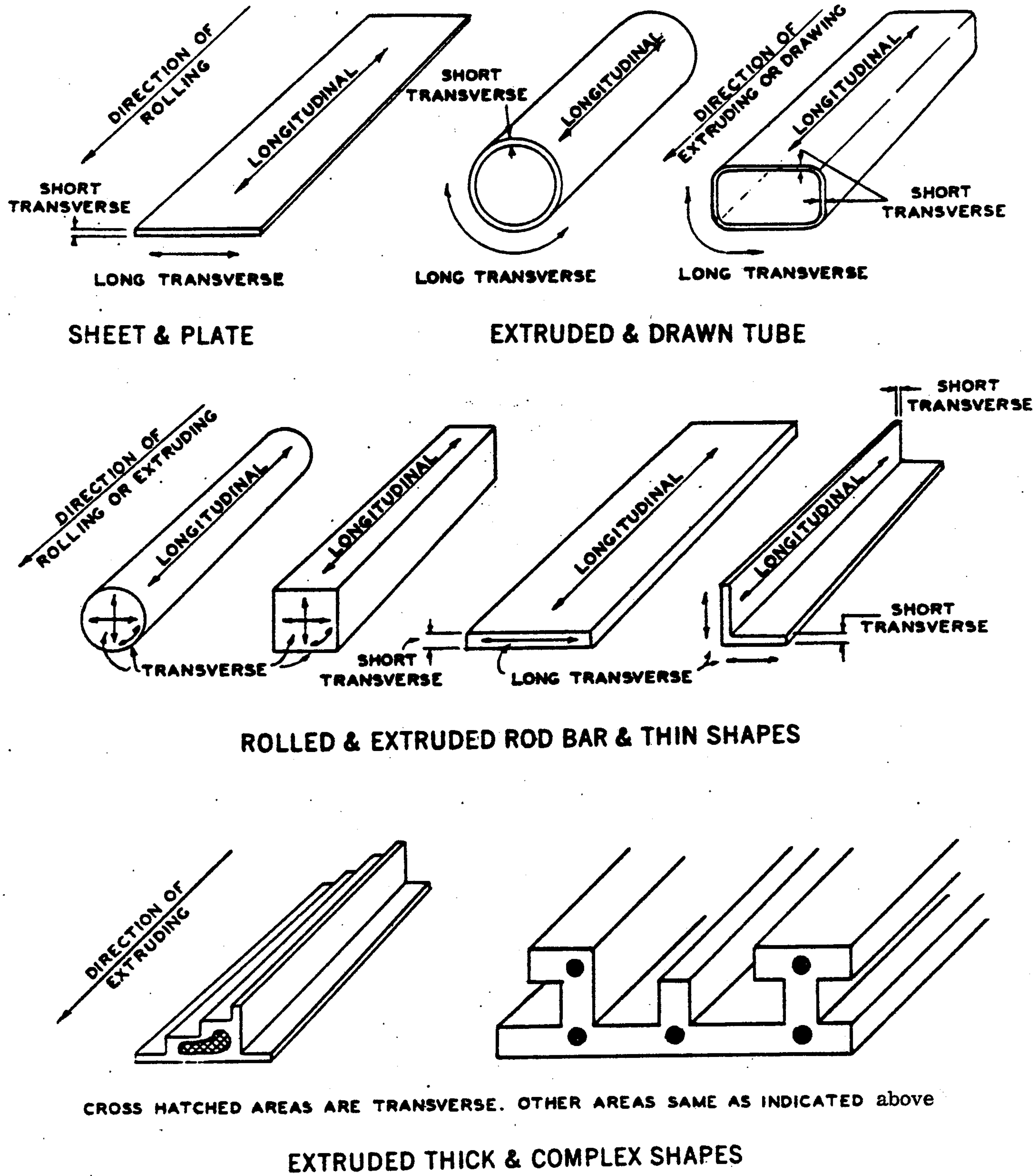
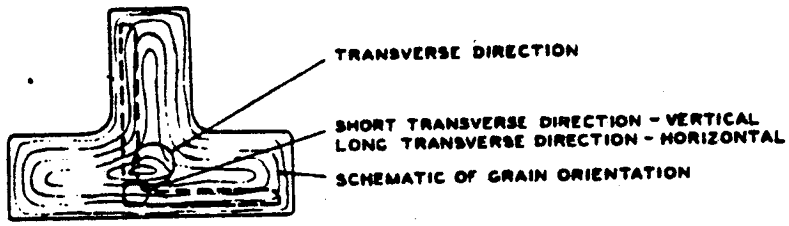
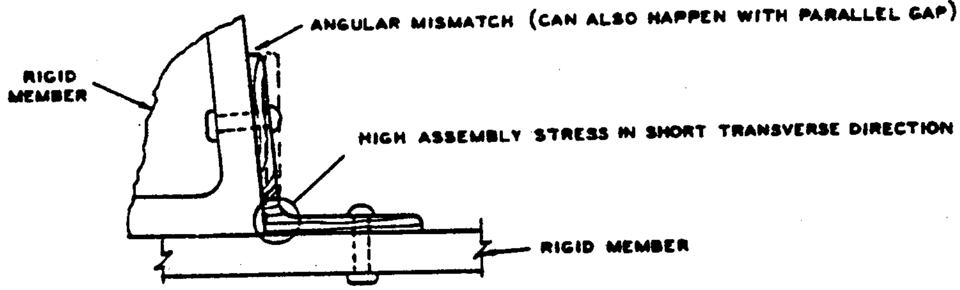


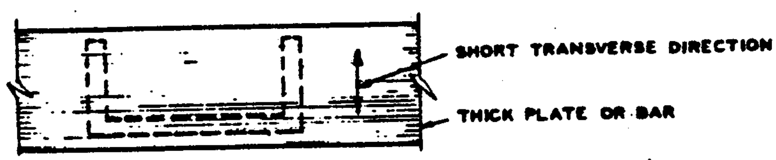
FIGURE 1 - GRAIN ORIENTATIONS IN STANDARD WROUGHT FORMS



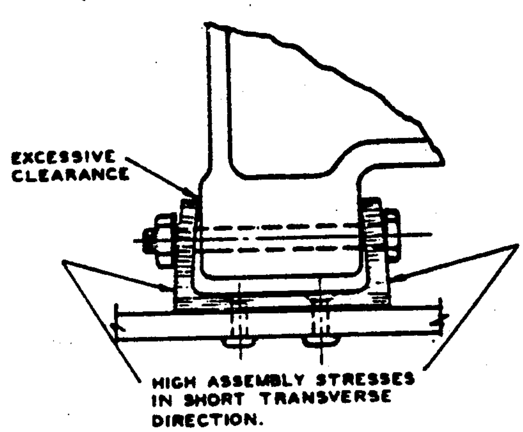
LOCATION OF MACHINED ANGLE WITH RESPECT TO TRANSVERSE GRAIN FLOW IN THICK TEE



ASSEMBLY STRESS RESULTING FROM MISMATCH

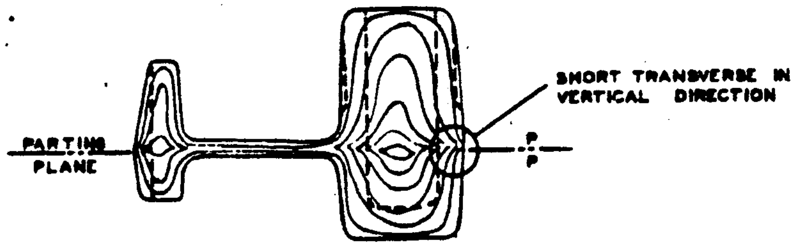


LOCATION OF MACHINED CHANNEL IN PLATE OR BAR

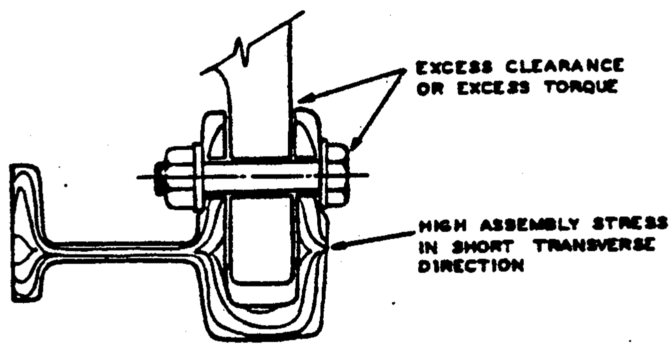


ASSEMBLY STRESS RESULTING FROM EXCESSIVE CLEARANCE

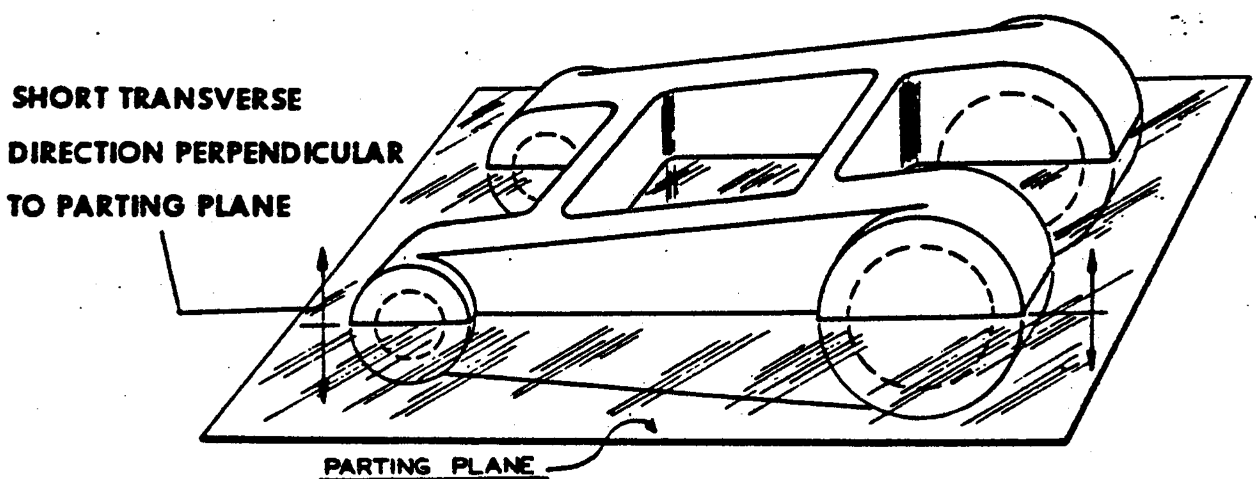
FIGURE 2 - EXAMPLES OF TENSILE STRESSES IN SHORT TRANSVERSE DIRECTION APPLIED DURING ASSEMBLY



CROSS SECTION OF DIE FORGING SHOWING OUTLINE OF MACHINED PART

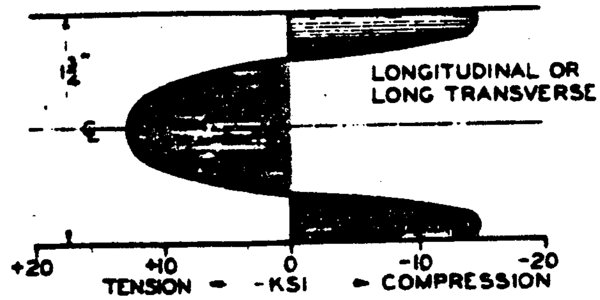


ASSEMBLY STRESS IN MACHINED FORGING WITH EXCESSIVE CLEARANCE

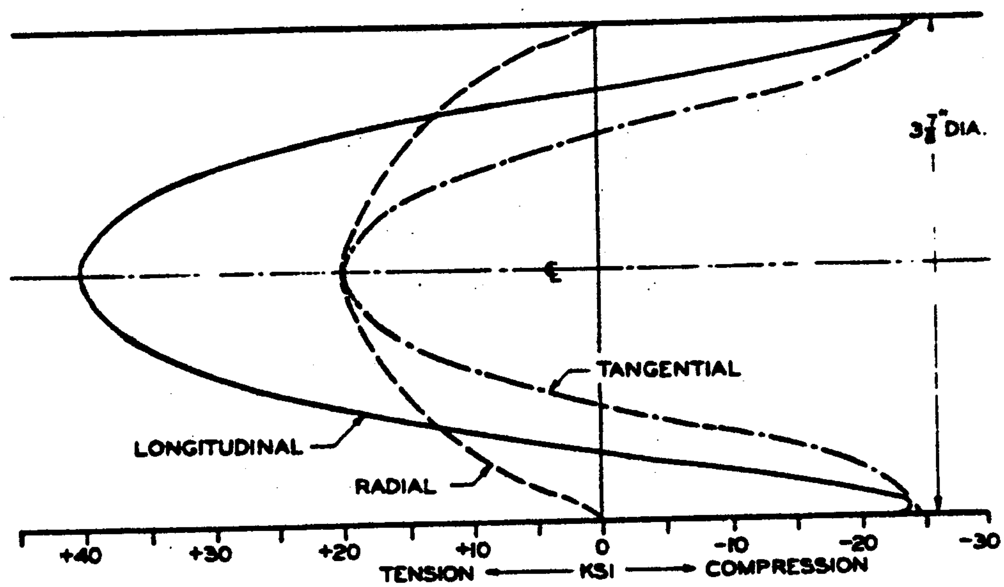


TYPICAL DIE FORGING, INTERFERENCE FIT BUSHINGS OR PINS IN HOLES SHOWN BY DASHED LINES IMPOSE SUSTAINED RESIDUAL TENSILE STRESSES IN TRANSVERSE DIRECTION

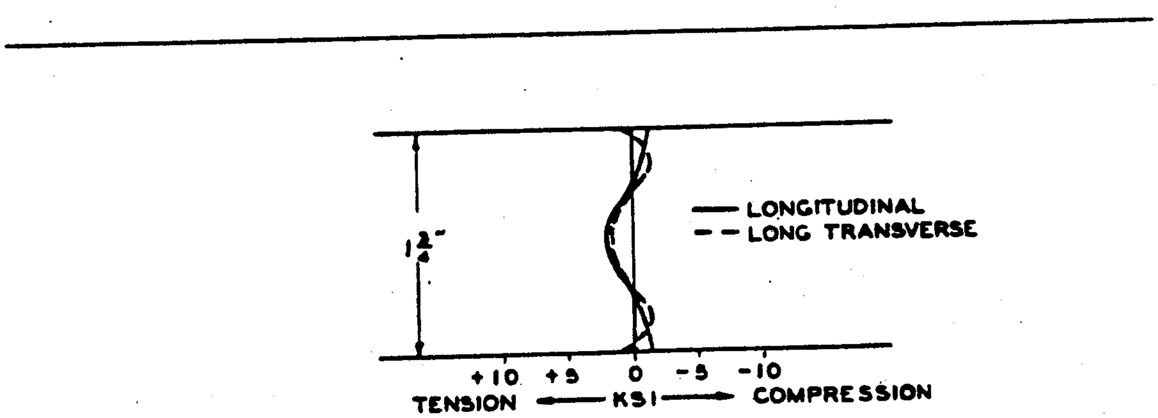
FIGURE 3 - EXAMPLES OF TENSILE STRESSES IN SHORT TRANSVERSE DIRECTION RESULTING FROM ASSEMBLY



7075-T6 PLATE, QUENCHED IN COLD WATER AND NOT STRESS RELIEVED



7075-T6 ROD, QUENCHED IN COLD WATER AND NOT STRESS RELIEVED.



7075-T651 PLATE, STRETCHED 2% AFTER COLD WATER QUENCH.

FIGURE 4 - TYPICAL RESIDUAL STRESS DISTRIBUTIONS IN 7075 ALUMINUM ALLOY SHAPES

TABLE I

ALLOYS WITH HIGH RESISTANCE TO STRESS CORROSION CRACKING

STEEL ALLOYS

Alloy	Condition
Carbon Steel (1000 Series)	Below 180 ksi UTS
Low Alloy Steel (4130, 4340, D6AC, etc.)	Below 180 ksi UTS(1)
Music Wire (ASTM 228)	Cold Drawn
HY-80 Steel	Quenched and Tempered
HY-130 Steel	Quenched and Tempered
HY-140 Steel	Quenched and Tempered
1095 Spring Steel	Quenched and Tempered
300 Series Stainless Steel (unsensitized)(2)	All
21-6-9 Stainless Steel	All
Carpenter 20 Cb Stainless Steel	All
Carpenter 20 Cb-3 Stainless Steel	All
A286 Stainless Steel	All
AM350 Stainless Steel	SCT 1000 and Above
AM355 Stainless Steel	SCT 1000 and Above
Almar 362 Stainless Steel	H1000 and Above
Custom 455 Stainless Steel	H1000 and Above
15-5 PH Stainless Steel	H1000 and Above
PH 14-8 Mo Stainless Steel	CH900 and SRH950 and Above
PH 15-7 Mo Stainless Steel	CH900
17-7 PH Stainless Steel	CH900
Nitronic 33(3)	All

(1) A small number of laboratory failures of specimens cut from plate greater than 2 inches thick have been observed at 75% of yield even within this ultimate strength range. The use of thick plate should therefore be avoided in a corrosive environment when sustained tensile stress in the short transverse direction is anticipated.

(2) Including Weldments of 304L, 316L, 321 and 347.

TABLE I

ALLOYS WITH HIGH RESISTANCE TO
STRESS CORROSION CRACKING
(Continued)

NICKEL ALLOYS

Alloy	Condition
Hastelloy C	All
Hastelloy X	All
Incoloy 800	All
Incoloy 901	All
Incoloy 903	All
Inconel 600(3)	Annealed
Inconel 625	Annealed
Inconel 718(3)	All
Inconel X-750	All
Monel K-500(3)	All
Ni-Span-C 902	All
Rene 41'	All
Unitemp 212	All
Waspaloy	All

(3) Including Weldments.

TABLE I

ALLOYS WITH HIGH RESISTANCE TO
STRESS CORROSION CRACKING
(Continued)

ALUMINUM ALLOYS

Wrought[1][2]		Cast	
Alloy	Condition	Alloy[3]	Condition
1000 Series	All	355.0, C355.0	T6
2011	T8	356.0, A356.0	All
2024 Rod, Bar	T8	357.0	All
2219	T6, T8	B358.0 (Tens-50)	All
3000 Series	All	359.0	All
5000 Series	All[4][5]	380.0, A380.0	As Cast
6000 Series	All	514.0 (214)	As Cast[5]
7049	T73	518.0 (218)	As Cast[5]
7149	T73	535.0 (Almag 35)	As Cast[5]
7050	T73	A712.0, C712.0	As Cast
7075	T73		
7475	T73		

(1) Mechanically stress relieved (TX5X or TX5XX) where possible.
(2) Including weldments of the weldable alloys.
(3) The former designation is shown in parenthesis when significantly different.
(4) High magnesium content alloys 5456, 5083, and 5086 should be used only in controlled tempers (H111, H112, H116, H117, H323, H343) for resistance to SCC and exfoliation.
(5) Alloys with magnesium content greater than 3.0 percent are not recommended for high temperature application, 66°C (150°F) and above.

TABLE I

ALLOYS WITH HIGH RESISTANCE TO
STRESS CORROSION CRACKING
(Continued)

COPPER ALLOYS

CDA No.[1]	Condition (% Cold Rolled)[2]
110	37
170	AT, HT[3]
172	AT, HT[3]
194	37
195	90
230	40
422	37
443	10
510	37
521	37
619	40 (9% B phase)
619	40 (95% B phase)
688	40
706	50
725	50, Annealed

MISCELLANEOUS ALLOYS

Wrought

Alloy	Condition
Beryllium, S-200C	Annealed
HS 25 (L605)	All
HS 188	All
MP35N	All
Titanium, 3Al-2.5V	All
Titanium, 6Al-4V	All
Titanium, 13V-11Cr-3Al	All
Magnesium, M1A	All
Magnesium, LA141	Stabilized
Magnesium, LAZ933	All

(1) Copper Development Association alloy number.
(2) Maximum percent cold rolled for which SCC data is available.
(3) AT - Annealed and precipitation hardened.
HT - Work hardened and precipitation hardened.

TABLE II

ALLOYS WITH MODERATE RESISTANCE TO STRESS CORROSION CRACKING

STEEL

Alloy	Condition
Carbon Steel (1000 Series)	180 to 200 ksi UTS
Low Alloy Steel (4130, 4340, D6AC, etc.)	180 to 200 ksi UTS
Nitronic 32	All
Nitronic 60	All
403, 410, 416, 431 Stainless Steel	(1)
PH 13-8 Mo Stainless Steel	All
15-5PH Stainless Steel	Below H1000
17-4PH Stainless Steel	All

MISCELLANEOUS ALLOYS

Alloy	Condition
Magnesium, AZ31B	All
Magnesium, ZK60A	All

(1) Tempering between 700 and 1100°F should be avoided because corrosion and stress corrosion resistance is lowered.

TABLE II

ALLOYS WITH MODERATE RESISTANCE TO
STRESS CORROSION CRACKING
(Continued)

ALUMINUM ALLOYS(2)(3)

Wrought		Cast	
Alloy	**Condition**	**Alloy**	**Condition**
2024 Rod, Bar, Extrusion	T6, T62	319.0, A319.0	As Cast
2024 Plate, Extrusions	T8	333.0, A333.0	As Cast
2124 Plate	T8		
2048 Plate	T8		
4032	T6		
5083	All(4)		
5086	All(4)		
5456	All(4)		
7001	T75, T76		
7049	T76		
7050	T736, T76		
7075	T76		
7175	T736, T76		
7475	T76		
7178	T76		

(1) Tempering between 700 and 1100°F should be avoided because corrosion and stress corrosion resistance is lowered.

(2) Mechanically stress relieved products (TX5X or TX5XX) should be specified where possible.

(3) Sheet, unmachined extrusions, and unmachined plate are the most resistant forms.

(4) Except for the controlled tempers listed in footnote 3 of Table I, Aluminum Alloys. These alloys are not recommended for high temperature application, 66°C (150°F) and above.

TABLE III

ALLOYS WITH LOW RESISTANCE TO
STRESS CORROSION CRACKING
(Continued)

COPPER ALLOYS

CDA No.[1]	Condition[2] (% Cold Rolled)
260	50
353	50
443	40
672	50, Annealed
687	10, 40
762	A, 25, 50
766	38
770	38, 50, Annealed
782	50

MAGNESIUM ALLOYS

Alloy	Condition
AZ61A	All
AZ80A	All

(1) Copper Development Association alloy number.
(2) Rating based on listed conditions only.

APPENDIX A

LIST OF SELECTED REFERENCES ON STRESS CORROSION

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2. Spuhler, C. H. and Burton, C. L., "Avoiding Stress Corrosion Cracking in High Strength Aluminum Alloy Structures, " Aluminum Company of America, August 1, 1962

3. Rutemiller, H. C. and Sprowls, D. O., "Stress Corrosion of Aluminum - Where to Look for it, How to Prevent it," Paper presented at 18th Conference and Corrosion Show of N. A. C. E., March 19-23, 1962.

4. "Stress Corrosion Cracking in Aircraft Structural Materials," AGARD Conference Proceedings Series No. 18, April 18 and 19, 1967.

5. Logan, H. L., "The Stress Corrosion of Metals," John Wiley and Sons, Inc., New York, 1966.

6. Humphries, T. S. and Nelson, E. E., "Stress Corrosion Cracking Evaluation of Several Ferrous and Nickel Alloys," April 2, 1970 NASA TMX-64511.

7. Williamson, James G., "Stress Corrosion Cracking of Ti-6Al-4V Titanium Alloy in Various Fluids," November 19, 1969. NASA TMX-53971.

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12. Humphries, T. S. and Nelson, E. E., "Stress Corrosion Cracking Susceptibility of 18 Ni Maraging Steel," April 1974. NASA TMX-64837

APPENDIX A (CONTINUED)

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15. "Stress Corrosion Cracking of High Strength Alloys," Aerojet-General Corp., Report No. DA-04-495-ORD-3069, August 1961

16. Bloom, F. K., "Stress Corrosion Cracking of Hardenable Stainless Steels," Armco Research Laboratories, Corrosion, Vol. II, August 1955.

17. Kaltenhauser, R. H., "Stress Corrosion Resistance of AM-350," Allegheny Ludlum Steel Corp. Report No. SS-450, October 1961.

18. Leckie, H. P. and Loginow, A. W., "Stress Corrosion Behavior of High Strength Steels," U. S. Steel Corp., Corrosion, Vol. 24, No. 9, September 1968

19. Loginow, A. W., "Stress Corrosion Cracking of Austenitic Stainless Steel in Marine Environment," U. S. Steel Corp., Unpublished Memorandum, June 11, 1965.

20. Nelson, E. E., "Stress Corrosion Cracking of Several High Strength Ferrous and Nickel Alloys," November 11, 1971. NASA TMX-64626

21. Popplewell, J. M., and Gearing, T. V., "Stress Corrosion Resistance of Some Copper Base Alloys in Natural Atmospheres," Olin Metals Research Laboratories, Corrosion, Vol 31, No. 8, August 1975.

APPENDIX B

MATERIAL USAGE AGREEMENT			
PROJECT ________ SUBSYSTEM ________		USAGE AGREEMENT NO. ________	
ORIGINATOR ________		PAGE ____ OF ____	
ORGANIZATION ________			
DETAIL DRAWING	NOMENCLATURE	USING ASSEMBLY	NOMENCLATURE
MATERIAL & SPECIFICATION		MANUFACTURER & TRADE NAME	

USAGE	THICKNESS	WEIGHT	EXPOSED AREA	ENVIRONMENT		
				PRESSURE	TEMPERATURE	MEDIA

APPLICATION

RATIONALE

MSFC/MATERIALS & PROCESSES LABORAT.

ACCEPT ________ DATE ________
REJECT ________ DATE ________

ORIGINATOR	PROGRAM MANAGER	DATE	MATERIALS APPLICATIONS EVALUATION BD.
			ACCEPT ________ DATE ________ REJECT ________ DATE ________

EH01-E (ONE TIME) FORM 1 (MARCH 1975)

APPENDIX C

STRESS CORROSION EVALUATION FORM

1. Part Number________ ________________
2. Part Name________________________
3. Next Assembly Number____________________
4. Manufacturer________________________
5. Material________________________
6. Heat Treatment________________________
7. Size and Form________________________
8. Sustained Tensile Stresses-Magnitude and Direction
   a. Process Residual________________________
   b. Assembly________________________
   c. Design, Static________________________
9. Special Processing________________________
10. Weldments
    a. Alloy Form, Temper of Parent Metal________________
    b. Filler Alloy if none, indicate________________
    c. Welding Process________________________
    d. Weld Bead Removed - Yes ( ), No ( )________________
    e. Post-Weld Thermal Treatment________________
    f. Post-Weld Stress Relief________________
11. Environment________________________

APPENDIX C (CONTINUED)

12. Protective Finish ______________________

13. Function of Part ______________________

____

14. Effect of Failure ______________________

____

15. Evaluation of Stress Corrosion Susceptibility ______________________

____

16. Remarks: ______________________

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APPENDIX C (CONTINUED)

1-4. Part Identification - Information identifying specific part being evaluated. These headings may be modified as needed.

5. Material - Material should be identified as specified on drawing. Specific alloy and temper designation of raw material from which part is fabricated should be given.

6. Heat Treatment - All thermal treatments which the part receives should be listed.

7. Size and Form - Approximate dimensions of raw material from which part is fabricated should be listed. The raw material form (bar, plate, sheet extrusion, forgings, etc.) should also be shown.

8. Sustained Tensile Stresses - An estimation of all sustained tensile stresses should be made. The stresses should be listed according to their source (8a. Process, b. Assembly, c. Design) and the basis on which the estimation was made. Any special precautions taken to control stresses should be noted.

9. Special Processing - Any processes used for reducing tensile stresses (such as shot peening or stress relief treatments) should be noted.

10. Weldments - An SCC evaluation should be made of all weldments and all information that may assist in the evaluation should be submitted. The alloy, form, and temper of the parent metal, filler alloy if any, welding process, weld bead removed, post-weld thermal treatment or stress relief as listed in 10a. through 10f. is the type of information required.

11. Environment - An evaluation should be made as to the corrosive environment to which the part will be exposed during its lifetime. This includes exposure during fabrication, assembly, and component storage as well as environmental conditions during use.

12. Protective Finish - Any finishes which are applied for corrosion protection or finishes which might affect the basic corrosion resistance of the component should be listed.

13. Function of Part - The basic function of the part (or if more pertinent the assembly) should be listed.